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'Cross-section gastroenterostomy' in patients with irresectable periampullary carcinoma

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Background

The most frequent complication following gastroenterostomy (GE) for gastric outlet obstruction is delayed gastric emptying (DGE), which occurs in roughly 20% of patients. There is evidence that DGE may be linked to the longitudinal incision of the jejunum and that a transverse incision (cross-section GE) may decrease the incidence of DGE following GE.

Patients and methods

In contrast to the orthodox GE, the jejunum is severed transversely up to a margin of 1.5 cm at the mesenteric border and the anastomosis is created with a single running suture. A Braun anastomosis is added 20–30 cm distally to the GE. Patients were followed prospectively with special regard to the occurrence of DGE.

Results

Between 1 August 1994 and 1 August 1998, 25 patients underwent cross-section GE, mostly because of an irresectable periampullary carcinoma. Eight patients exhibited clinical signs of gastric outlet obstruction preoperatively, while in 17 the GE was performed on a prophylactic basis. A biliary bypass was added in 15 patients. There was no disruption of the GE, but one patient died in hospital (4%). The nasogastric tube was withdrawn on the first postoperative day (range 0–6 days), a liquid diet was started on the fifth day (range 2–7 days) and a full regular diet was tolerated at a median of 9 days (6–14 days). The incidence of DGE was 4%: only the single patient who died fulfilled the formal criteria for DGE.

Discussion

In contrast to orthodox GE, DGE seems to be of minor clinical importance following cross-section GE. As the technique is easy to perform, is free of specific complications and leads to a low incidence of DGE, it should be considered as an alternative to conventional GE.

Keywords

gastroenterostomy, gastric outlet obstruction, delayed gastric emptying.

Introduction

Palliation is surely the most frequent surgical action in patients with pancreatic carcinoma. Although more and more surgeons tend to carry out palliative resections when feasible [1], the vast majority of patients presenting with obstructive jaundice and gastric outlet obstruction (GOO) will undergo bypass surgery. Few would deny the palliation of jaundice that is achieved by biliary bypass and of symptomatic GOO, whether subtotal or total, that is achieved by gastroenterostomy (GE). However, the indication for a prophylactic GE because of impending or threatened GOO is still a matter of much debate.

The chief cause for questioning the value of a prophylactic GE is the concern that many surgeons have about the increased morbidity incurred by simultaneous biliary bypass and GE [2–8]. However, the Mayo Clinic experience [2] demonstrated clearly that nearly all the increase in postoperative complications following simultaneous bypass is linked to delayed gastric emptying (DGE) during the early postoperative course and not to surgical complications such as bleeding and anastomotic disruption of the additional gastroenteric anastomosis. DGE following GE is a frustrating and frequent problem that most surgeons will have encountered. The pathogenesis of this phenomenon is controversial, and many potential factors have been identified: tumour cell infiltration of the splanchnic nerves [9], preoperative duodenal obstruction [10], malignancy [10], old age [10], malnutrition [11],

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Roux-en-Y reconstruction [12] and previous gastric surgery [12].

In 1928, Moise [13] reported a simple mechanical cause of impaired gastric emptying following GE, confirming results published by Cannon and Blake in 1905 [14]. On the basis of experimental studies, they noted that impaired emptying of food through the GE was linked to the longitudinal incision of the jejunum, which severs the circular muscle fibres and therefore interferes with peristalsis throughout the length of the anastomosis. Probably even more decisive is a 'valve-like' action of the orthodox longitudinal incision of the efferent loop: when the wall of the stomach is distended (for example due to postoperative atony of the foregut) so that the anastomosis is stretched, the openings into the intestine become mere narrow slits (Figure 1). These slits should 'offer a valve-like hindrance to the egress of food from the stomach via the stoma' [13]. The more the gastric wall is distended, the more effective the valves become; the process represents a vicious circle. Moise therefore modified the conventional GE by cutting the jejunum in a transverse fashion, thus inaugurating the 'cross-section GE'. The circular muscle fibres are only minimally damaged by a transverse rather than a longitudinal incision, and peristalsis of the anastomosis is not disturbed. Moreover, the valve-like action of the conventional stoma is avoided. With distension of the gastric wall, there is widening of the jejunal stomas (Figure 2), as demonstrated experimentally [13].

Although convincing on theoretical grounds, this technique did not gain wide acceptance until 1987, when the working group of Trede [15] published their experience with this modification of the orthodox GE. We now report the results of this operation with special regard to gastric emptying.

Patients and methods

Cross-section GE was performed according to the original technique [13] as follows. First, an adequate jejunal loop was brought up through the transverse mesocolon after exposing the posterior wall of the stomach. In the case of tumour involvement of the transverse mesocolon, an antecolic GE was performed. The lumina of the jejunal loop on both sides of the anastomotic region were closed by two clamps, and the jejunal wall was opened via a transverse incision. The wall was divided almost completely up to a margin of 1–1.5 cm at the mesenteric border (Figure 3). Then, the clamps were separated from each other in a longitudinal direction, so that the jejunal lumen was com-

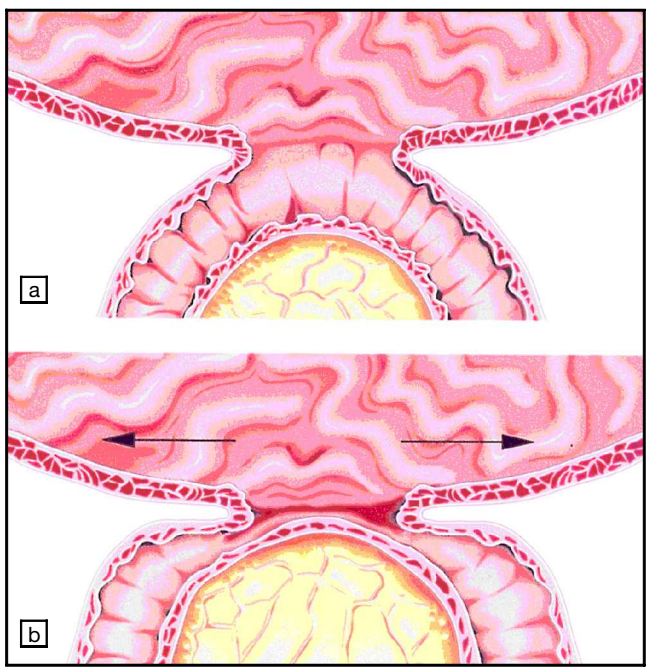

Figure 1. *Conventional GE (a). When the gastric wall is distended due to postoperative atony of the fore gut (b), the opening of the jejunum becomes a narrow slit ('valve-like' action of the anastomosis; modified from [13]).*

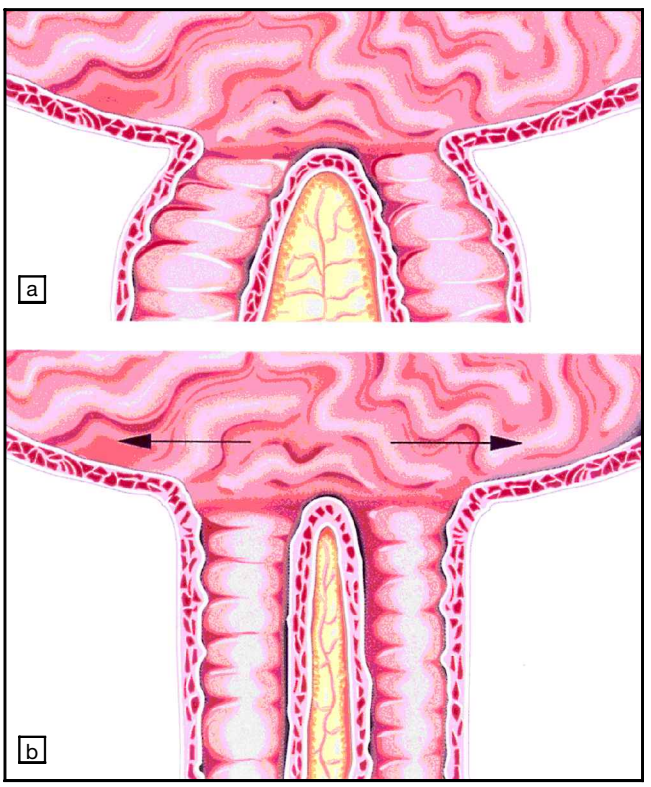

Figure 2. *Cross-section GE (a). When the gastric wall is distended (b), the openings of the jejunal lumina remain wide (no 'valve-like' action of the anastomosis; modified from [13]).*

Figure 3. *Transverse incision (arrow) of the jejunal loop (1=posterior gastric wall).*

pletely opened (Figure 4). The gastric wall was opened to the same length as the jejunal stoma, so that the length of the gastric incision was always determined by the diameter of the jejunal lumen. The anastomosis was then created using a single running suture, and a Braun anastomosis was added 20–30 cm distally to the GE (Figure 5).

In general, patients presenting with a pancreatic mass were evaluated preoperatively for the possibility of curative resection. Those with proven liver metastasis or peritoneal carcinomatosis were excluded from operation, together with those who had severe concurrent disease. For these patients, endoscopic biliary drainage was performed and GE was only carried out for those with symptomatic GOO.

The primary aim of surgical intervention for a pancreatic mass was the determination of resectability. Whenever appropriate, pancreatoduodenectomy was performed, but

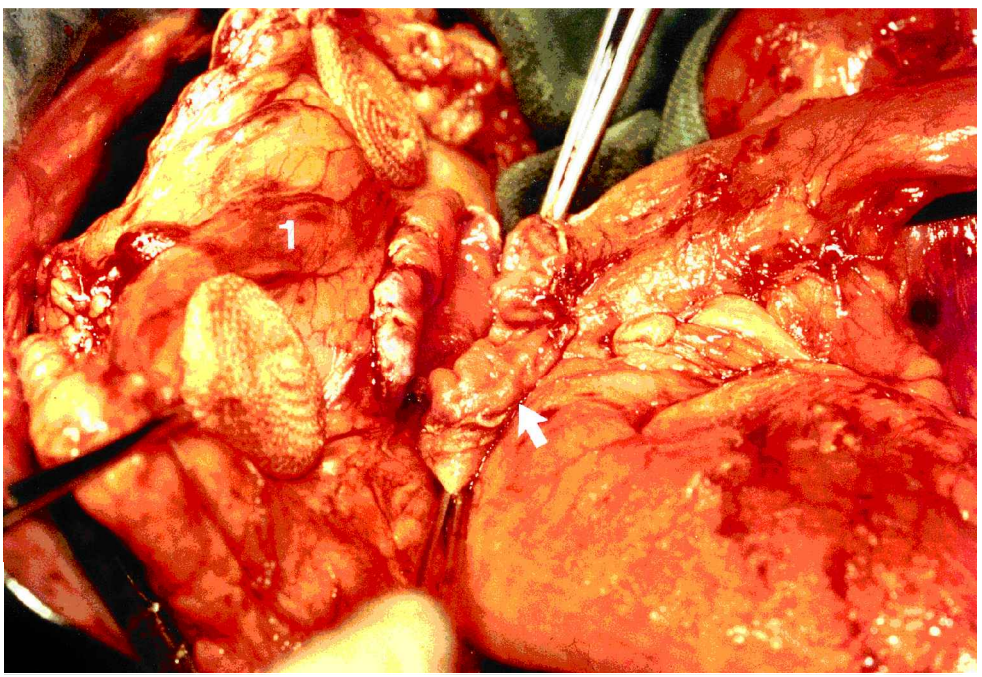

Figure 4. *The clamps are separated from each other in a longitudinal direction (arrow), and the length of the gastric incision is determined (1=posterior gastric wall).*

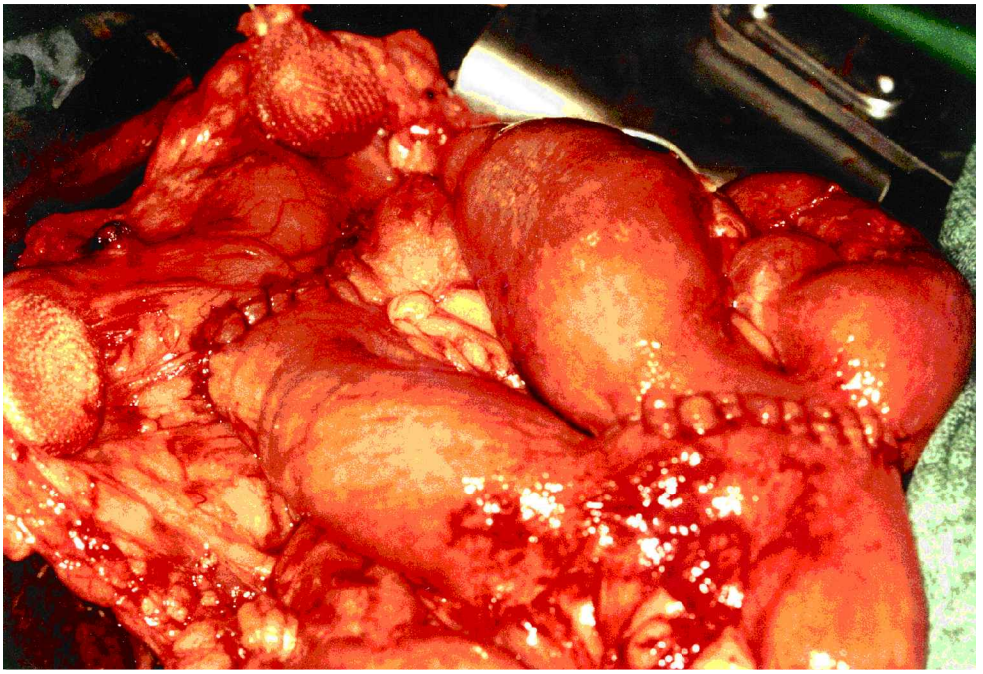

Figure 5. *Cross-section GE with Braun anastomosis.*

selected patients received a palliative resection. The tumour was judged unresectable if there was distant metastasis or major vascular involvement. Limited portal or mesenteric vein involvement and lymph node metastasis were not usually considered to be exclusion criteria for resection.

In fit patients with unresectable disease, GE was performed not only for actual GOO, but also on a prophylactic basis. In patients with preoperative GOO, the stomach was decompressed for 2 days by means of a nasogastric tube. During the postoperative course, the gastric tube was withdrawn when daily aspirates dropped below 200 ml. A liquid diet was started between the second and fifth postoperative days, depending on the presence of bowel sounds, and a full diet was established within a further 5 days.

DGE was defined as (1) the need for nasogastric decompression for more than 7 days or (2) the inability to tolerate a full diet by the fourteenth postoperative day without the need for parenteral nutrition or (3) if the nasogastric tube had to be reinserted because of nausea or vomiting.

The postoperative course of every patient was documented prospectively with special regard to postoperative complications, the number of days of nasogastric suction and the postoperative days on which liquid and solid diet was started.

Results

Between 1 August 1994 and 1 October 1998, 25 patients underwent cross-section GE. The underlying disease was malignant in every patient, pancreatic carcinoma being the commonest type (Table 1). The leading cause of unresectability was tumour involvement of the mesenteric root (21), followed by preoperatively unsuspected liver metastasis (3) and peritoneal carcinomatosis (1).

Table 1. *Patients undergoing GE (n=25)*

	n	%
Diagnosis		
–pancreatic carcinoma	20	80
–distal bile duct carcinoma	3	12
–duodenal carcinoma	2	8
Indication		
–prophylactic	17	68
–symptomatic	8	32
Reconstruction		
–retrocolic	20	80
–antecolic	5	20
Position		
–posterior gastric wall	23	92
–anterior gastric wall	2	8
Biliary-digestive anastomosis	17	68
Operative time [min], median (range)	185	(60–360)

Eight patients exhibited clinical signs of GOO preoperatively, while in the remaining 17 the GE was performed to prevent future GOO (prophylactic indication). Twenty patients received a retrocolic GE and 17 patients an additional biliary bypass. Mean operative time was 185 min (range 60–360 min), including the time taken to determine tumour resectability.

Twenty patients had an uneventful postoperative course, but the postoperative complications in the other five are shown in Table 2. Three patients had to be re-operated for disruption of the biliary anastomosis or bleeding; there were no leaks from the GE. One patient with metastatic carcinoma of the head of the pancreas died in the intensive care unit on the eighth postoperative day because of progressive cancer but without signs of local sepsis (hospital mortality 4%).

The nasogastric tube was withdrawn on the first postoperative day (range 0–6 days), and a liquid diet was started on the fifth day (range 2–7 days) (Table 3). In three patients, the nasogastric tube had to be reinserted because re-operation was required for a postoperative complication and not due to vomiting. Full oral diet was tolerated at a median of 9 days (6–14 days), and all surviving patients resumed feeding within 2 weeks. Therefore, DGE was virtually absent in this series: only one patient who died fulfilled the formal criteria (incidence of DGE 4%). The median hospital stay following operation was 11 days.

Table 2. *Postoperative complications following GE (BDA=biliary-digestive anastomosis)*

	n	%
Uneventful course	20	80
Anastomotic leakage (biliodigestive)	3	12
Wound infection	3	12
Bleeding	2	8
Anastomotic leakage (GE)	–	–
Re-operation	3	12
In-clinic mortality	1	4

Table 3. *Postoperative course following GE (DGE=delayed gastric emptying)*

	Median (range)
Gastric tube (postoperative days)	1 (0–6)
Reinsertion of gastric tube [*n* (%)]	3 (12%)
Liquid diet (postoperative days)	5 (2–7)
Full regular diet (postoperative days)	9 (6–14)
DGE [*n* (%)]	**1 (4%)**

Discussion

The published incidence of DGE after GE varies considerably from 9 to 26 % [2,5,8–10,16–18] (Table 4). Some of the variation may reflect different definitions of DGE: 8, 10 and 14 days have all been used. We have used relatively strict criteria, however. Although the incidence of DGE appears to be decreasing nowadays, it prolongs the period of discomfort associated with the need for nasogastric decompression. Moreover, gastric tubes are likely to foster silent aspiration and aspiration pneumonia [17,23]. DGE may increase the postoperative mortality rate [5,8,17], and it nearly doubles hospital stay in patients with a very limited prognosis [2,8]. Therefore, DGE is a major drawback to prophylactic GE and has led some authors to advocate antral resection or exclusion for irresectable pancreatic cancer [24], though these are much more extensive procedures. As recent reports have shown that simultaneous bypass is feasible with a low perioperative mortality rate [16,25] akin to that of biliary bypass alone [26,27], interest should focus on decreasing the incidence of DGE, thereby increasing the acceptability of prophylactic GE.

The present data from a limited number of patients show that DGE does not follow cross-section GE, but our study has several shortcomings. Its major drawback is the lack of a control group. In an attempt to compare the results with those from selected series of conventional GEs, the prognostic factors and incidence of DGE have been summarised in Table 4, although the rates are not necessarily comparable because of differing definitions. Nevertheless, the present rate of DGE compares favourably with that of conventional GE, even in patient series in which the prognostic factors for DGE (i.e. proportion of prophylactic GE) were distributed evenly. We cannot prove that the lack of DGE implies improved functioning of the cross-section GE, since in the 'prophylactic group' of patients emptying might recommence via the pylorus rather than the GE.

The incidence of DGE is clearly increased in patients with preoperative duodenal obstruction, in whom it reaches almost 50% [8,17]; such patients should receive preoperative nasogastric decompression. However, several authors have reported DGE after prophylactic conventional GE, with an incidence of roughly 15% [5,10,17] . The presumed cause of DGE in irresectable pancreatic cancer is tumour involvement of the coeliac axis with interruption to splanchnic innervation and consequent motility disorders [9,21].

Table 4. *Incidence of delayed gastric emptying (DGE) and distribution of prognostic factors following orthodox and cross-section GE in selected papers (BDA=biliary digestive anastomosis, n.s. = not stated)*

Author year	**Doberneck 1987 [17]**	**Woods 1989 [10]**	**Singh 1990 [18]**	**v.d.Schelling 1993 [9]**	**Wangenensveld 1997 [19]**
Study design	**retrospective**	**retrospective**	**retrospective**	**retrospective**	**retrospective**
N	57	322	70	48	120
Age	n.s.	59	n.s.	n.s.	n.s.
Male:female	n.s.	1.6:1	n.s.	1.1:1	n.s.
Malignant disease (%)	100	25	100	100	100
Prophylactic GE (%)	75	56	29	65	77
Antecolic GE (%)	79	12	n.s.	0	3
BDA (%)	70	n.s.	100	58	98
Morbidity (%)	n.s.	n.s.	n.s.	27	27
Mortality (%)	9	6	10	21	2
DGE (%)	**26**	**11**	**20**	**21**	**14**

Author year	**Bergamaschi 1998 [20]**	**Chaudhary 1999 [21]**	**Sohn 1999 [16]**	**Shyr 2000 [22]**	**Present study**
Study design	**n.s.**	**retrospective**	**retrospective**	**prospective**	**prospective**
N	22	39	180	44	25
Age	68	54	n.s.	67	62
Male:female	1:1,4	1:1,6	n.s.	1:5	1.4:1
Malignant disease (%)	100	100	100	100	100
Prophylactic GE (%)	41	44	n.s.	7	72
Antecolic GE (%)	n.s.	100	0		20
BDA (%)	59	38	73	66	60
Morbidity (%)	41	n.s.	28	11	20
Mortality (%)	23	5	3	9	4
DGE (%)	**23**	**21**	**9**	**11**	**4**

The low incidence of DGE in the present series cannot be attributed to the indication for operation, therefore. To the contrary, it may be explained on the basis of the experimental findings of Moise [13] and Cannon and Blake [14]: following laparotomy, foregut motility is temporarily impaired and especially in patients with unresected cancer of the pancreas. The subsequent distension of the gastric wall is likely to narrow the conventional anastomosis, initiating a cycle of mural stretching and stenosis of the stoma. This mechanism has been confirmed in the excised stomach by distending it with water [14]. Cross-section GE should interrupt this cycle since the anastomosis remains mechanically efficient while gastric motility is impaired.

In conclusion, cross-section GE should be considered as an alternative to conventional GE because it is easy to perform, free of specific complications and should result in a low incidence of DGE.

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